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TO: Mr. T.W.B. MacFarlane
Station Manager
Lakeview TGS

LAKEVIEW TGS
TEMPORARY ON-SITE ASH STORAGE

C.B.H. Cragg

Using the results of a subsurface investigation, area wind data and traffic patterns in the coal yard, a design for a temporary coal ash storage area, at the south end of the coal yard, was formed. This report presents the background information, the proposed ash storage area design and recommendations for operating the storage facility. Design and operation consider dust control, drainage, timing of facility construction, materials, equipment usage and ash reclamation processes.

1.0 INTRODUCTION

The storage volume available for permanent coal ash disposal is being rapidly depleted at the Canada Brick (Mississauga) quarry site. At mid-March, approximately 40,000 m^3 remained to be filled, which may be sufficient to serve Lakeview TGS's needs until summer. No alternative site has been approved for permanent coal ash disposal. It was therefore proposed to stockpile coal ash on site at Lakeview TGS on a temporary basis until sales agreements come into force and/or a new permanent disposal site is approved.

This study, undertaken at the request of Lakeview TGS, considers how the temporary ash stockpile should be structured, shaped and operated to meet the station's needs and to protect the environment. The station's anticipated maximum storage requirement for 25,000 Mg of coal ash forms the basis for the recommended actions in this report.

job	file	date	report no.
740643-187-50471	843.2	June 25, 1986	86-138-K

2.0 STORAGE LOCATION

The study request specified that only the south end of the coal pile be considered for temporary coal ash storage. This location, shown on Figure 1, is immediately north of the coal pile drainage lagoon and has an area of approximately 1 ha (2.5 acres). The coal pile is relatively flat in this location and has an elevation of about 80.8 m (265 feet). Storing the ash in this location will not interfere with scraper traffic on the coal pile or with access to the water supply for the coal pile dust control vehicle. Ash was previously stored in this location during May 1985.

3.0 ASH STORAGE CONSIDERATIONS

The storage area must be large enough to accommodate the ash handling traffic associated with winter station operation. Storage pile height should be kept between 2 to 3m to limit exposure to wind and dusting. Compaction of the disposed coal ash should be sufficient to support the disposal vehicles yet allow easy reclamation. The sides of the pile should be shaped and protected to prevent erosion by wind and rain. Leachate from the stored coal ash should be contained yet the work area should be kept dry for operations. Use of existing equipment for ash disposal and reclamation is desirable as on site disposal of ash at Lakeview GS is only a temporary measure until a new permanent site is found.

These items are addressed in the following sections.

4.0 SUBSOIL CONDITIONS

Three boreholes were drilled in the proposed storage area to determine the drainage and leachate transportation potential of the site. Figure 1 shows the locations of these borings. The soils encountered are shown in detail on the borehole logs (Figures 2 to 4). Figure 5 shows the interpreted subsoil stratigraphy across the proposed temporary ash storage area.

Up to 1.5 m (5 feet) of coal ash, from the May 1985 strike, was found at the surface of Boreholes 2 and 3. Beneath this coal ash and at the surface of Borehole 1, dense coal was encountered. The coal layer has a thickness varying from 0.5 - 1.0 m (1 1/2 to 3 feet) and is wet at the surface. Clean fill or silt underlie the coal at the three boreholes. The fill is a mixture of coal and sandy silt till which may have been placed when the coal pile drainage ponds were constructed about 1978 or when the south end of the coal pile was reclaimed from the lake in the 1960's. A compact to dense sandy silt till underlies the other strata at elevation 78.4 m (257 feet) or higher. Shale bedrock should be present beneath the till but was not encountered within the depth of the borings, which penetrated to about elevation 75 m (246 feet).

The coal and fill are expected to have low permeabilities with values lower than 10^{-5} cm per second. A permeability one to two orders of magnitude smaller is anticipated in the relatively impermeable sandy silt till.

No ground water was encountered in the boreholes. Maximum Lake Ontario water level is elevation 75.9 m (249 feet).

5.0 EXISTING STRUCTURES

As shown on Figure 1, the proposed temporary ash storage area is bounded on the lake side by a coal pile drainage ditch and associated ponds. The ponds are concrete structures which extend down into the sandy silt till and have bottom ash backfill next to their walls (see Figure 6). The perimeter ditch also extends to the till. Together these structures form an effective barrier to runoff and leach waters from the proposed temporary ash storage area.

6.0 STORAGE AREA FEATURES

To contain the stored ash, protect it from wind erosion and protect the ponds from silting, a set of 12 foot high dykes is proposed. The dyke configuration, shown in Figure 7, provides the required storage volume of 25,000 Mg within the traffic constraints to the north and west, and the physical constraints to the south and east. A 20 foot wide space has been provided for traffic access between the dykes and the ponds.

The dykes have been shaped to reduce wind effects from directions which may affect neighbors. Wind data from Toronto Island, presented in the form of a wind rose (Figure 8), shows that only winds from the southwest and northeast are likely to affect neighbors because they have a frequency of 15% to 18% and are on shore. Other frequent wind directions are either offshore or towards the Lakeview Generating Station. Dykes on the south, southwest and northeast edges of the proposed ash storage area have been given a gentle 3:1 upwind slope and a steep downwind slope (Figure 9) to protect ash stored in their lee. This method of dust protection has been recommended for use at Nanticoke TGS/1/. A flat space has been provided on top of these dyke segments to accommodate wind screens, should these be required at some future date. Other dykes, which are primarily for containment, are steep on both sides (Figure 9). These dykes may be constructed of well compacted coal or bottom ash.

7.0 DRAINAGE

As wet fly ash does not support traffic well, it is important to keep the temporary storage area as dry as possible. The dykes should protect the area from surface runoff from the coal pile. A slight mounding of the north entrance area and grading of the area outside the dykes to direct runoff away from the entrance will complete the protection from external surface water. A series of French drains is recommended for assisting drainage within the storage area. These drains would be spaced at 15 m (50 foot) intervals and should run from just inside the dykes in the North West to the edge of the ponds or ditch, beyond the dykes, in the South East (Figure 10). The French drains should be at least 0.6 m (2 feet) wide by 1.0 m (3 feet) deep. Bottom ash may be used as the permeable drain material. To prevent contamination of this filter material with coal dust, the French drain should be wrapped with a geotextile where it passes beneath the perimeter dykes.

8.0 OPERATION

Two approaches have been used for previous coal ash landfills. At Canada Brick and at structural fill sites, the ash has been dumped on level ground, spread in about 30 cm (1 foot) layers and compacted by vibratory rollers. At Nanticoke, Booth quarry, Clarkson Park and Ambler Courtney, ash was dumped or pushed over a bank, spread in about 1.5 m (5 foot) layers and compacted only by spreading equipment (bulldozer or front end loader). Each method has its pros and cons.

The structural fill method (Figure 11) allows work to be done in the protection of the berms, gives better support to vehicle traffic and maximizes the weight of ash that may be packed into the storage area. These benefits are offset by the greater effort required to place the ash and potential difficulties in reclaiming the ash.

The dump fill method (Figure 12) minimizes the placing effort and creates a fill with the least resistance to reclamation. Accompanying these benefits are an increased exposure to wind and a reduced ability to support traffic, particularly in wet weather. Less ash will be placed in the available storage volume using this method.

Either approach may be chosen for ash placement. Regardless of the choice, it is recommended that filling start against the southwest berm and proceed northeast (see Figure 13). At Lakeview, a bulldozer may be used as the primary means of compaction in the structural fill method. The smooth drum compactor should be used to seal any area that will be left open for a period of time, such as at the end of a shift. To derive the best compaction with the least effort the ash should be placed near its optimum water content of about 28%. For effective mixing, this water must be added at the silo and not by water truck. If it is planned to store ash from the bottom ash settling ponds in this area, this ash should be stored separately from the "dry" silo ash to maintain good support for traffic.

In areas that will be left exposed to wind and drying for a period of more than a few days, long term dust prevention techniques should be used. These techniques include chemical dust control sprays or surface cover material. Surface chemicals, such as Bondall, have been found effective for dust control in non traffic areas at Nanticoke TGS/4,5/. Soil or bottom ash may be used as cover material. In winter, artificial snow has been used at the Canada Brick fill site and found effective, while sub-zero weather persists.

9.0 CONSTRUCTION SEQUENCE

The system of French drains, for controlling water within the temporary ash fill area, should be installed first. Berms to enclose the area on the South, West and East should be built next. The berms along the North side of the ash storage area and the northern portion of the East and West berms may be constructed later, after some ash landfilling has occurred. All other berms should be in place before ash placing is started.

Where berms are not constructed around the ash landfill area at the start of the operation, ridges about 1/2 m (18 inches) high should be placed as a temporary measure to divert coal pile runoff away from the area. Construction of berms may be most easily accomplished during warm weather months. To avoid winter construction difficulties, enough berms should be constructed ahead of time to accommodate the anticipated winter ash storage requirements.

10. RECLAMATION

Working from the coal base of the ash storage area, the ash may be reclaimed by front end loader or by backhoe. The front end loader has the greatest chance of success where ash has been stored by the dump method because the lower parts of this fill will still be in a loose condition. Ash placed by the structural fill method may prove too difficult to excavate by front end loader, unless a very powerful machine is used, and removal by a large bucket backhoe may be required.

Field experience will dictate whether it is necessary to excavate some of the base coal when reclaiming the ash. The front end loader may not have good traction on ash, particularly if it is loose and wet.

When the need for the temporary ash storage facility expires, the berm materials may also be reclaimed and used. Bottom ash may be sold. Coal may be burned in the plant.

11. SUMMARY

A plan for temporary ash storage at Lakeview TGS coal yard has been presented. The plan includes confining berms for dust control and runoff control. Subsurface drains are included for drainage control. Available load materials, bottom ash and coal, are suitable materials for constructing these facilities. A sequence of construction and suggested methods of operating the storage area were also presented.

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1. Lepage, M.F. and Davies, A.E. "Dust Control Study for The Nanticoke TGS Fly Ash Lagoon", Morrison Hershfield Ltd. Report #4851618-1, February 1986.

2. Lepage, M.F. and Davies, A.E. "Dust Dispersion Study for Nanticoke TGS Ash Lagoon", Morrison Hershfield Ltd. Report #4851618-2, February, 1986.

3. Ontario Ministry of the Environment, "Annual Wind Roses for Ontario", Air Resources Branch Report WR-78-1, 1978.

4. Cragg, C.B.H. "Behaviour of Dust Control Agents Applied to Fly Ash Under Winter Conditions", Research Division Report #85-275-K, 1985.

5. Cragg, C.B.H. "Nanticoke TGS Ash Lagoon Dust Control Study", Research Division Report #80-470-K, 1980.

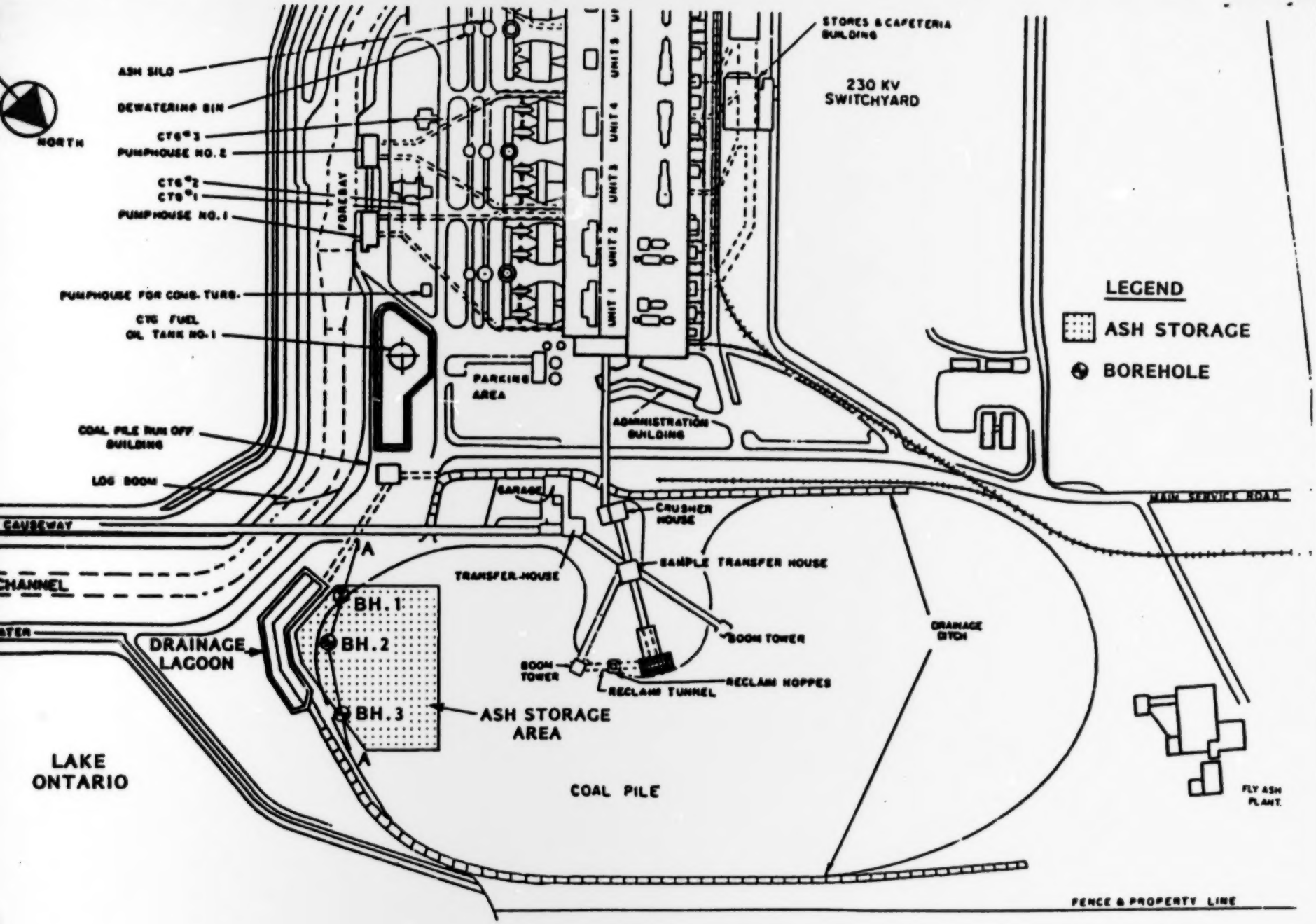


FIGURE 1

TEMPORARY ASH STORAGE LOCATION AT LAKEVIEW TGS

PROJECT LAKEVIEW GS - ASH STORAGE | HOLE TYPE SOLID AUGER | OBSERVER D.S.F.

LOCATION SEE FIGURE 1 | HOLE SIZE 4" | COMPILED C.B.C.

DIP | DRILLED 86-03-10 | CHECKED

DATUM | BEARING | DRAWN | APPROVED

BORING DATA						BORING LOG		WATER INF.		FIELD TESTS		LABORATORY TESTS					
SCALE - FEET	ELEV / DEPTH	(1) SAMPLE NO	(2) SAMPLE TYPE	(3) 'N' VALUE per 0.3m / RQD - %	(4) WATER LEVEL and CAVING / W.R.	(5) DESCRIPTION	(6) REMARKS	(7) OBSERVATION WELL DATA	(8) 'k' soil/rock cm/s / WATER PRESS. TEST	(9) SPECIAL TESTS TYPE	(9) SPECIAL TESTS RESULTS	NATURAL DENSITY kg/m³	MOISTURE CONTENT - %	(10) SHEAR STRENGTH kPa TYPE	(10) SHEAR STRENGTH kPa RESULTS	(11) SPECIAL TESTS TYPE	(11) SPECIAL TESTS RESULTS
	1	1A		97		COAL, BLACK, WET AT SURFACE, VERY DENSE							20.4				
	2	2A		48		2.5'						2226	10.0				
	3					FILL, MIXED COAL AND SILT TILL, COMPACT											
	4	3A		31									12.4				
	5																
		4A		22		5.5'							13.0				
	6					SANDY SILT TILL, SOME SMALL GRAVEL, COMPACT											
	7	5A		34								2331	8.9				
	8	6A		25		GRAVELLY SAND SEAM FROM 7' TO 9 1/2'							8.0				
	9																
	10	7A		18									5.3				
	11																
	12																
	13	8A		25								2148	19.8	U/C	136		
	14																
	15																
	16	9A		22								2077	20.1	U/C	105		
						16.5'											
	17					END OF BOREHOLE											

dwg no 2005R8 RD

GEOTECHNICAL DATA SHEET

hole no 1 | Fig 2

sheet 1 OF 1

PROJECT LAKEVIEW GS - ASH STORAGE | HOLE TYPE SOLID AUGER | OBSERVER D.S.F.

LOCATION SEE FIGURE 1 | HOLE SIZE 4" | COMPILED C.B.C.

DIP | DRILLED 86-03-10 | CHECKED

DATUM | BEARING | DRAWN | APPROVED

BORING DATA						BORING LOG	WATER INF.		FIELD TESTS		LABORATORY TESTS					
SCALE - FEET	ELEV / DEPTH	(1) SAMPLE NO	(2) SAMPLE TYPE	(3) 'N' VALUE per 0.3m / ROD-%	(4) WATER LEVEL and CAVING / W.R.	(5) DESCRIPTION	(6) REMARKS	(7) OBSERVATION WELL DATA	(8) 'k' soil/rock cm/s / WATER PRESS. TEST	(9) SPECIAL TESTS TYPE	(9) SPECIAL TESTS RESULTS	NATURAL DENSITY kg/m³	MOISTURE CONTENT - %	(10) SHEAR STRENGTH kPa TYPE	(10) SHEAR STRENGTH kPa RESULTS	(11) SPECIAL TESTS TYPE	(11) SPECIAL TESTS RESULTS
1						COAL ASH, GREY, DAMP											
2						2.0'											
3		1A		39		COAL, BLACK, DENSE							11.4				
4		2A		29		3.5'						1851	12.6				
5		3A		33		FILL, MIXED COAL AND SILT TILL, COMPACT						2112	12.8				
6		4A		40		6.5'						2247	15.0				
7		5A		22		SANDY SILT TILL, SOME GRAVEL, COMPACT TO DENSE						2349	14.1				
8		6A		37								2237	8.4				
9		7A		17									14.8				
10		8A		13									14.4				
11		9A		50/6"									14.6				
12						18.5'											
13						END OF BOREHOLE											
14																	
15																	
16																	
17																	
18																	
19																	
20																	

GEOTECHNICAL DATA SHEET

hole no 2 | Fig 3

sheet 1 OF 1

dwg no 28545 RD

PROJECT LAKEVIEW TGS - ASH STORAGE — HOLE TYPE SOLID AUGER — OBSERVER D.S.F.

LOCATION SEE FIGURE 1 — HOLE SIZE 4" — COMPILED C.B.C.

DIP — DRILLED 86-03-10 — CHECKED

DATUM — BEARING — DRAWN — APPROVED

BORING DATA						BORING LOG		WATER INF.		FIELD TESTS		LABORATORY TESTS					
SCALE - FEET	ELEV / DEPTH	(1) SAMPLE NO	(2) SAMPLE TYPE	(3) 'N' VALUE per 0.3m / RQD-%	(4) WATER LEVEL and CAVING / W.R	(5) DESCRIPTION	(6) REMARKS	(7) OBSERVATION WELL DATA	(8) 'k' cm/s WATER PRESS. TEST	(9) SPECIAL TESTS TYPE	(9) SPECIAL TESTS RESULTS	NATURAL DENSITY kg/m³	MOISTURE CONTENT - %	(10) SHEAR STRENGTH kPa TYPE	(10) SHEAR STRENGTH kPa RESULTS	(11) SPECIAL TESTS TYPE	(11) SPECIAL TESTS RESULTS
1						COAL ASH, GREY, DAMP											
2																	
3																	
4																	
5		1A		15		5.0'							32.3				
6						COAL, BLACK, DENSE												
7		2A		46									9.3				
8		3A		33		8.0'							13.6				
9						8.5' SILT, BROWN, DENSE												
10		4A		28		SANDY SILT TILL, SOME GRAVEL, COMPACT TO DENSE						2223	13.6				
11		5A		47									7.1				
12																	
13		6A		20									5.6				
14																	
15																	
16		7A		37								2228	11.4				
17																	
18		8A		24									14.1				
19																	
20																	
21		9A		32		21.5'						2193	14.2				
22						END OF BOREHOLE											

GEOTECHNICAL DATA SHEET

hole no 3 — Fig 4

sheet 1 OF 1

DR 86502 no 2

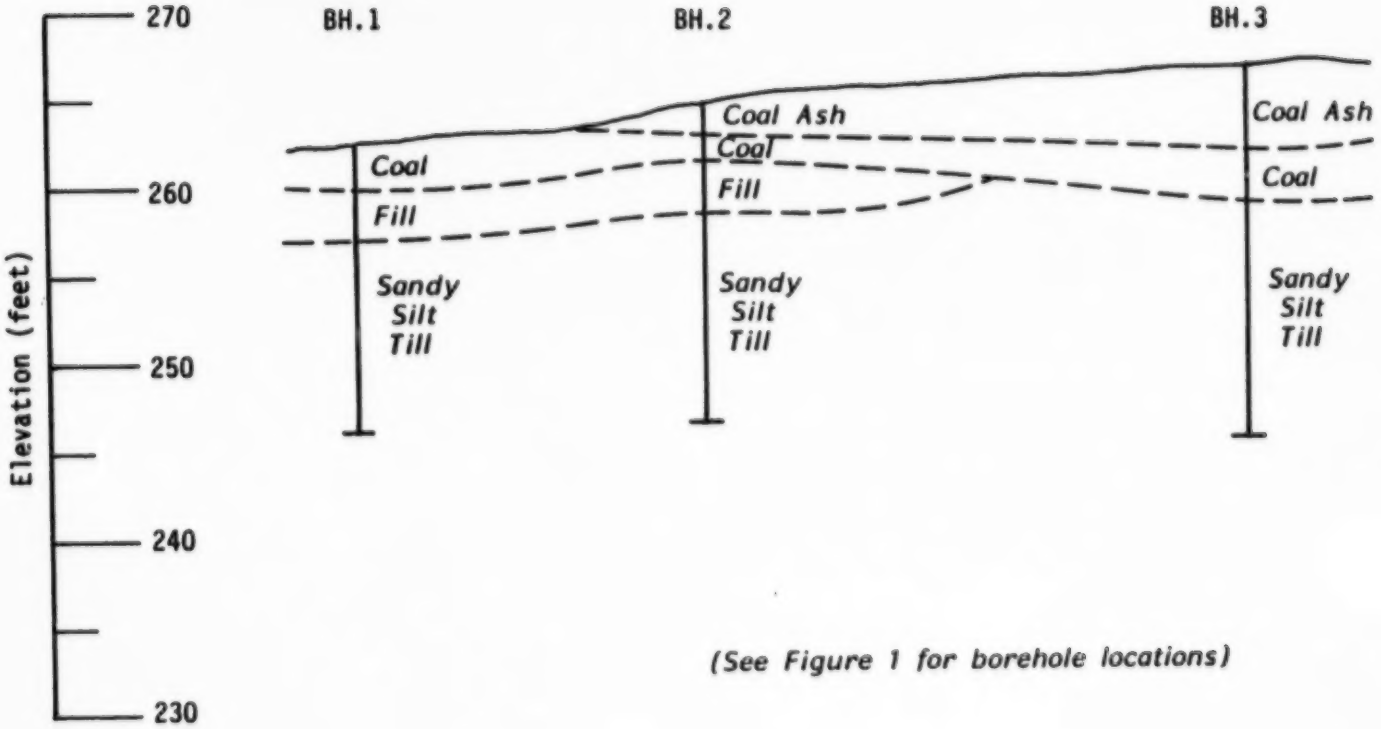


FIGURE 5

LAKEVIEW TGS COAL PILE INTERPRETED
STRATIGRAPHY AT SECTION A-A

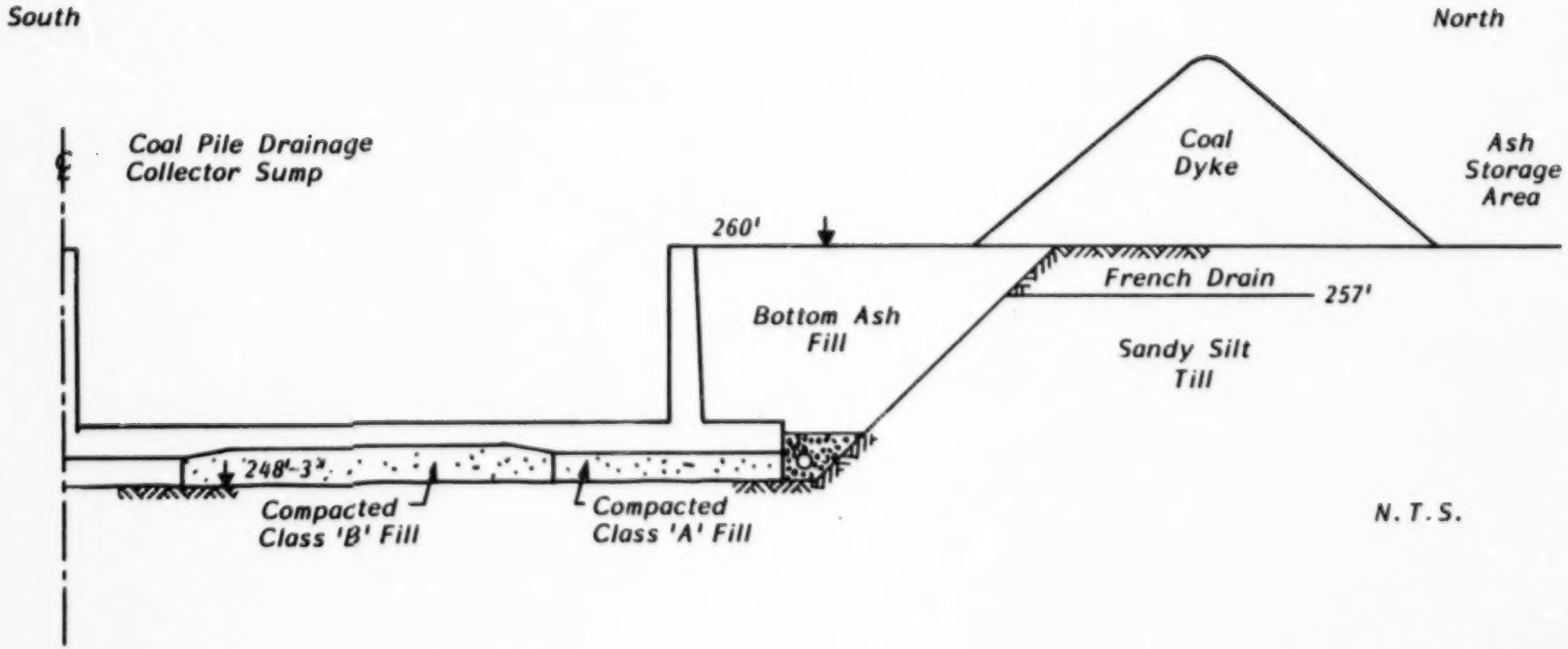
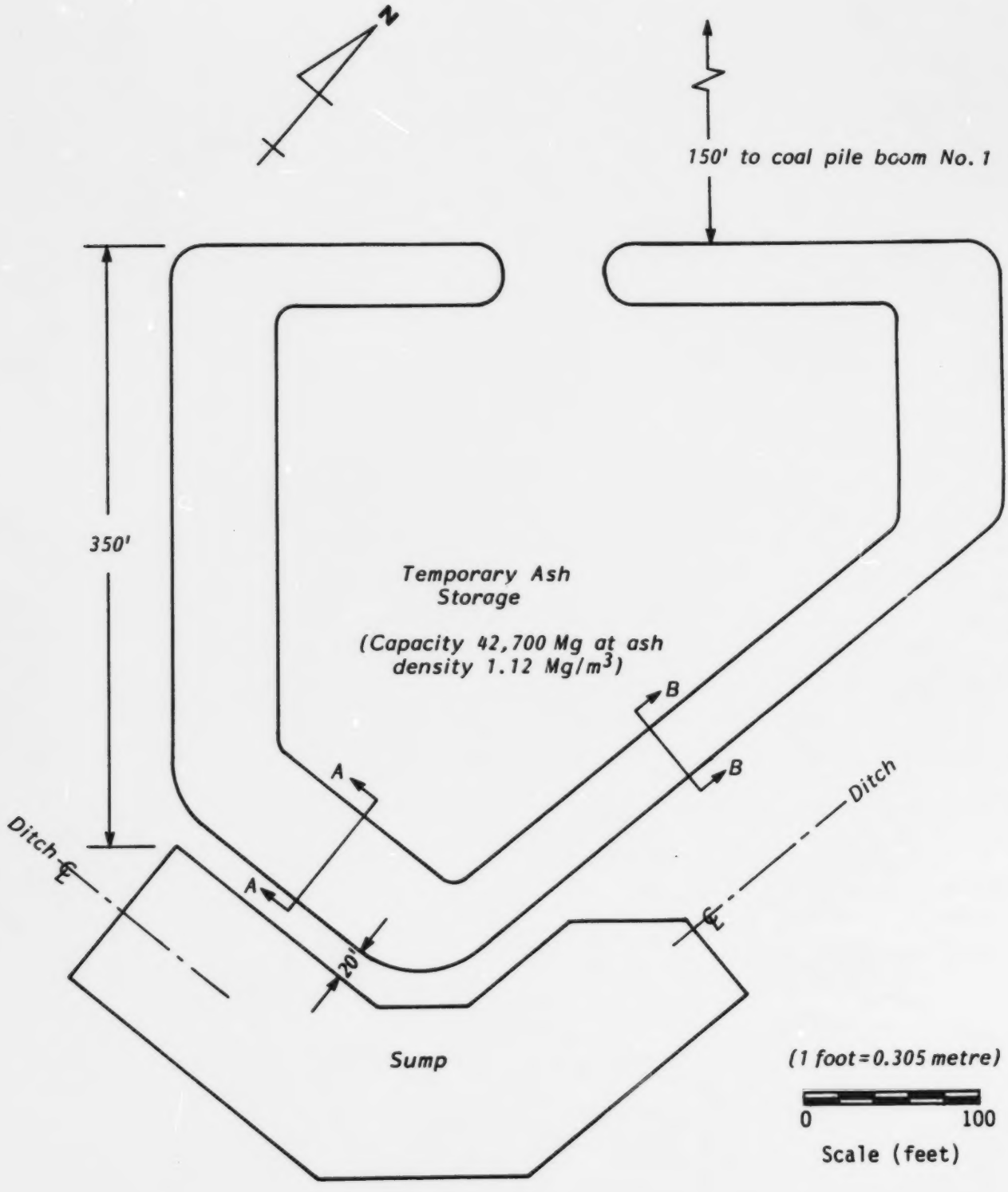


FIGURE 6
COAL DRAINAGE SUMP

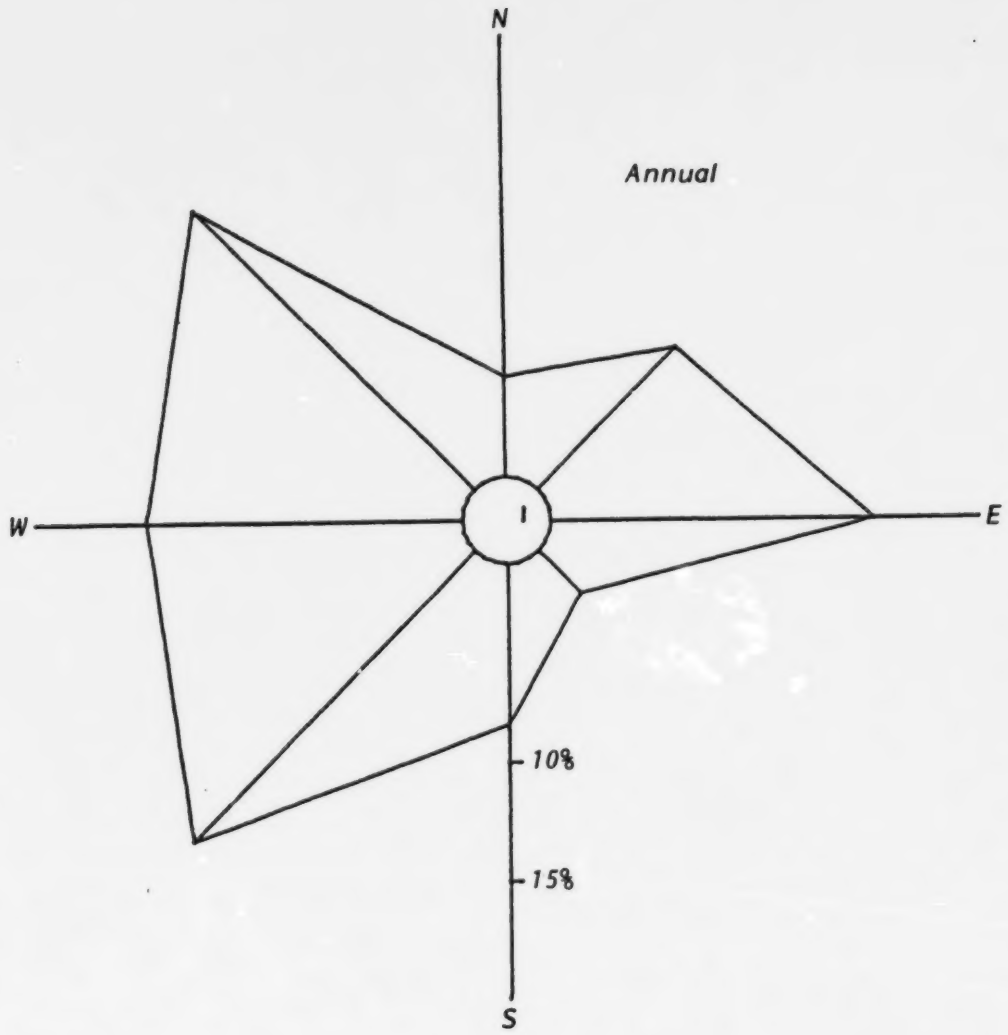


(See Figure 9 for cross sections A & B)

FIGURE 7

PERIMETER DYKE LOCATIONS FOR ASH STORAGE AREA

171426 F



Station Information

Located NW end of island, anemometer is on admin. bldg, well exposed to N with some sheltering from hangers NW and bldgs to NE. Height 18.2m.

FIGURE 8

ANNUAL WIND DIRECTION FREQUENCIES /3/
TORONTO ISLAND (A) (AES) 1955-1972

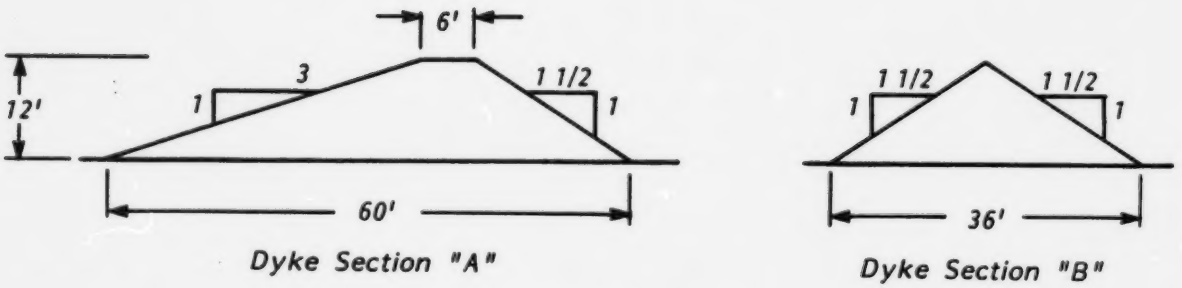


FIGURE 9
DYKE CROSS-SECTIONS

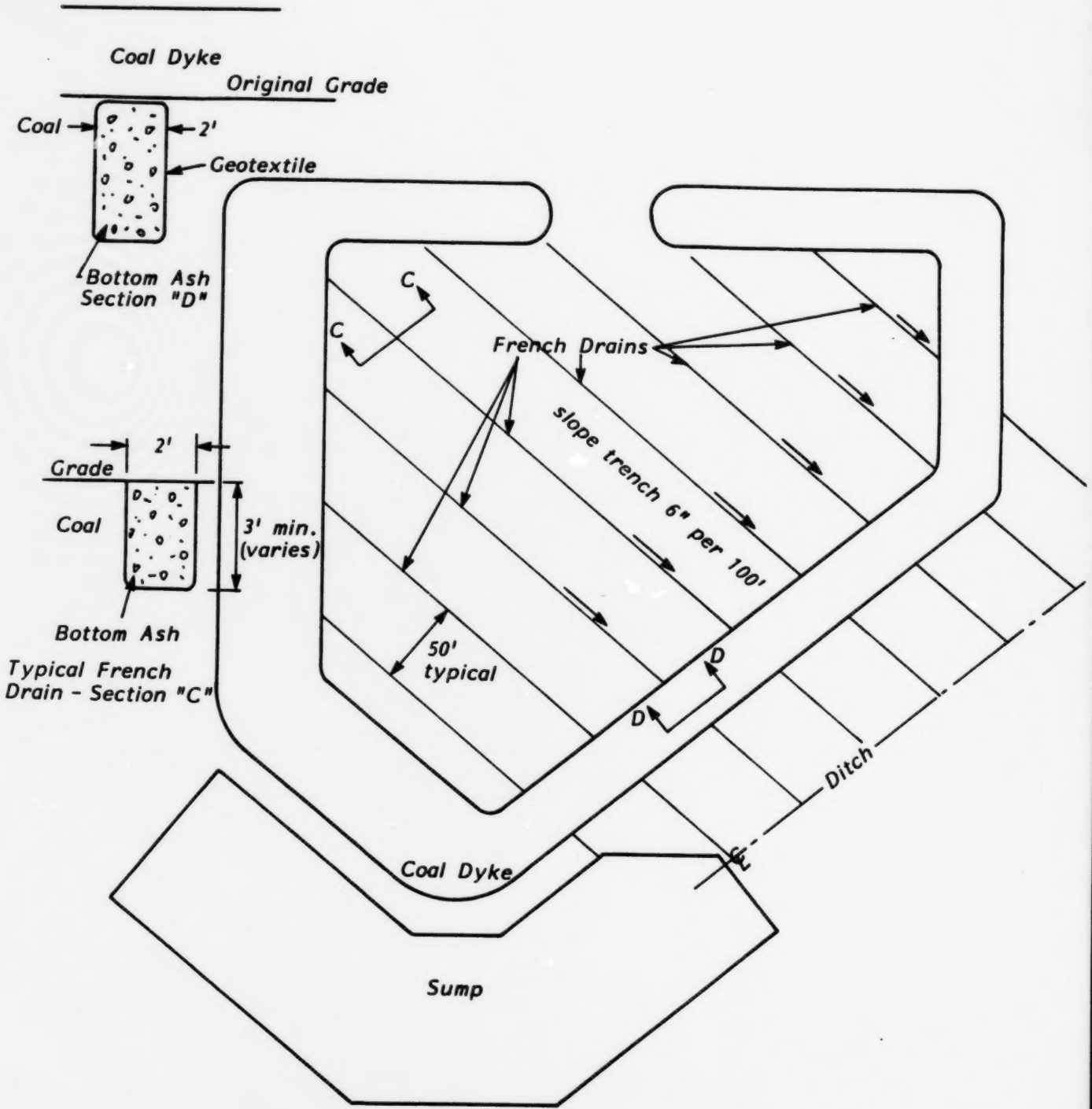


FIGURE 10

PLAN OF FRENCH DRAIN LOCATIONS

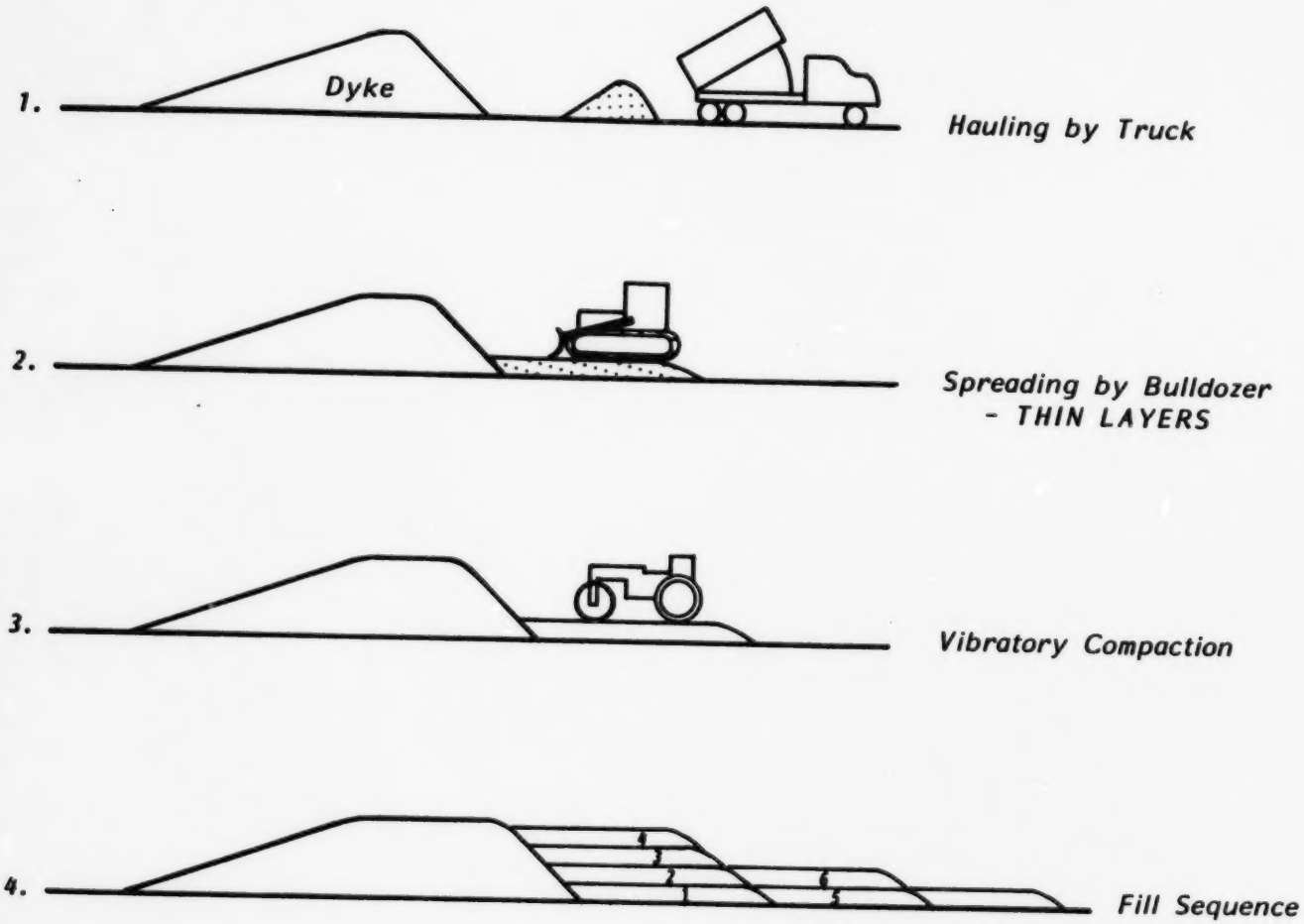


FIGURE 11
STRUCTURAL FILL METHOD OF ASH PLACEMENT

171430 RJ

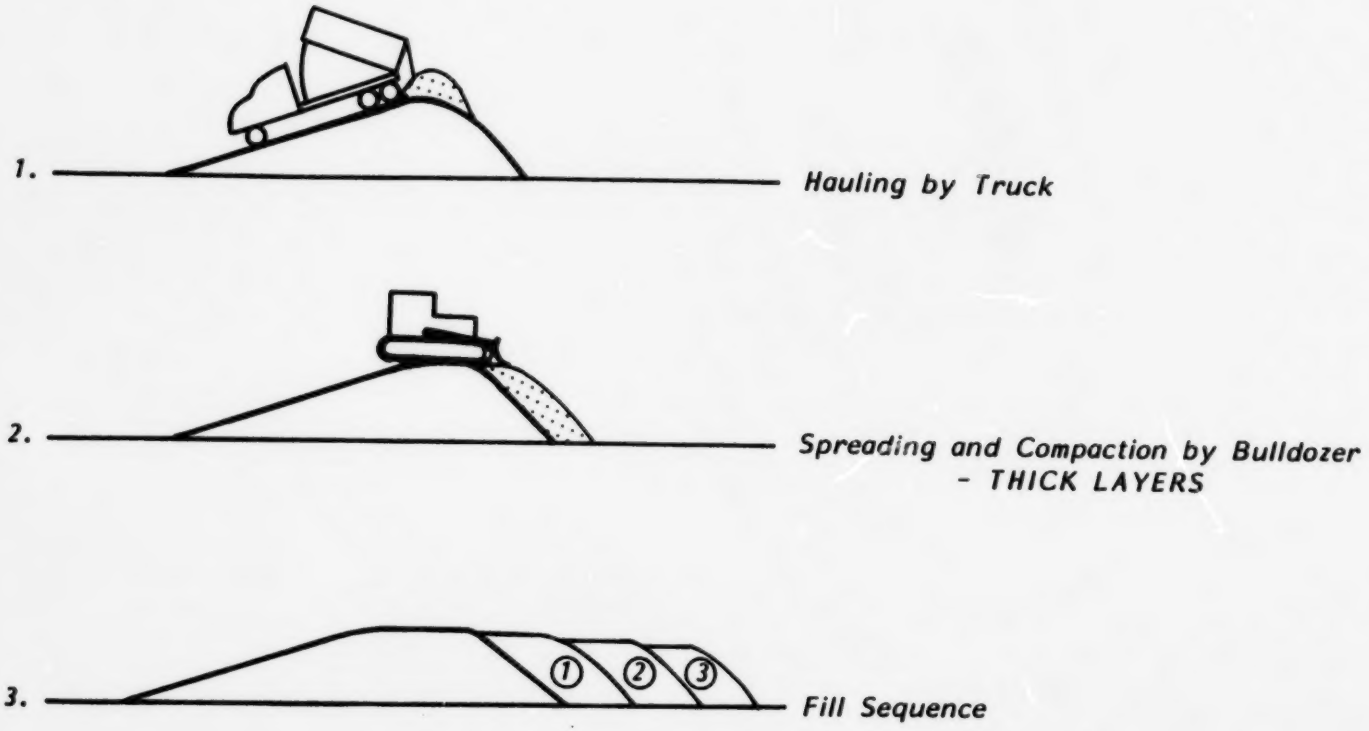


FIGURE 12
DUMP METHOD OF ASH PLACEMENT

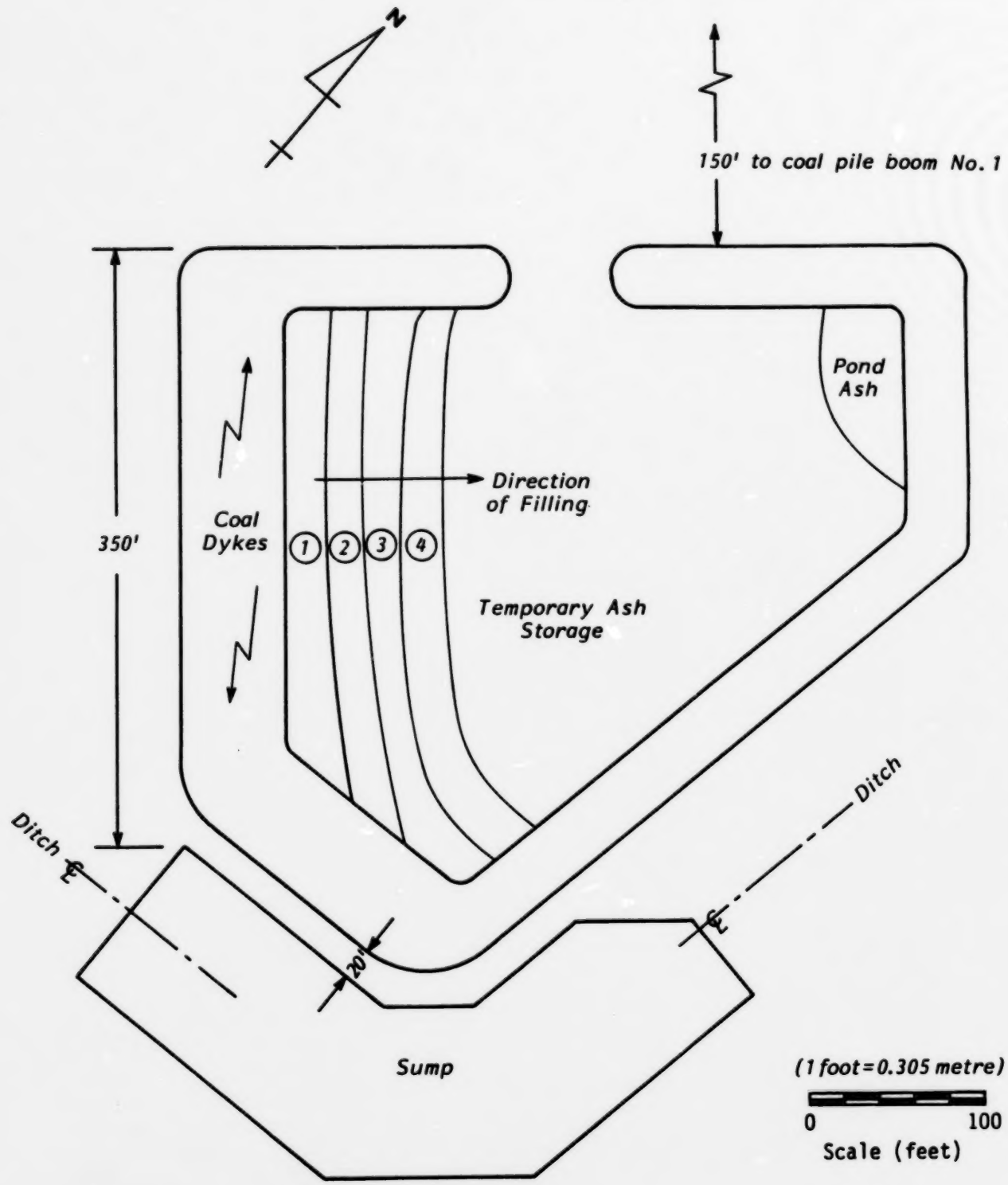


FIGURE 13

FILLING SEQUENCE FOR ASH STORAGE AREA